Introduction to the papers of TWG12: History in mathematics education

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CERME9 was the fourth time of the TWG on "History in Mathematics Education". For CERME9 the group had fourteen papers and two posters, and around twenty participants in the sessions. TWG12 covers a range of topics related to history in mathematics education, but on an overall scale, submissions to the group may be distinguished by either concerning "History in Mathematics Education" (HiMEd) or "History of Mathematics Education" (HoMEd). This time round, the group had five papers addressing topics of HoMEd, while the remaining nine papers and two posters were concerned with issues of HiMEd at various educational levels, which also included teacher education.

BULLETS IN THE TWG12 CALL FOR PAPERS

For CERME9, TWG12 in particular welcomed empirical and theoretical research papers and posters, but to some degree also methodological and developmental papers related to one or more of the following issues (bullets below) – although any paper/poster of relevance to the overall focus of the group was taken into consideration:

- Ways of integrating original sources in classrooms, and their educational effects, preferably with conclusions based on classroom experiments;
- Surveys on the existing uses of history or epistemology in curricula, textbooks, and/or classrooms in primary, secondary, and tertiary levels;
- Design and/or assessment of teaching/learning materials on the history of mathematics;
- The role of history or epistemology of mathematics at the primary, secondary, and tertiary level, and in pre- and in-service teacher education, from cognitive, pedagogical, and/or affective points of view;
- Investigations or descriptions of the historical instances of research cultures and cultures of teaching and learning in mathematics;
- Relationships between (frameworks for and empirical studies on) history in mathematics education and theories and frameworks in other parts of mathematics education;
- Possible parallelism between the historical development and the cognitive development of mathematical ideas;
- Theoretical, conceptual and/or methodological frameworks for including history in mathematics education;
- The potential role of history of mathematics/mathematical practices in relation to more general problems and issues in mathematics education and mathematics education research.

FOUR AREAS OF QUESTIONS FOR REFLECTIONS DURING SESSIONS

The work following the presentations of participants' papers and posters was orchestrated by four overarching themes cutting across the topics of papers:

Meta-level or methodological reflections on HiMEd and HoMEd

- What (if any) is (could be) the role assigned to epistemological/historical reflection in some major mathematics education theoretical frameworks: e.g. TDS; ATD; APOS; MKT; etc.?

- With regard to the local/global tension: Can large-scale surveys (e.g., history of algebra, historical development of geometry, notion of proof from Euclid to Hilbert, evolution of the concept of function, etc.) go beyond the "bird's eye view"? Can we elicit necessary conditions for such large-scale surveys to make any sense? Is the "epistemological narrative" the only way to organize historical material on a large scale?

HiMEd – the student perspective

- Which theoretical perspectives provide fruitful orientation for empirical studies designed to measure students' engagement/learning/etc. of mathematics (when history of mathematics is "used")? What measures are valued in such studies? What methods of analysis can be (should be) employed?

- What is the role of students' mathematical ability (or mathematical interest or prior mathematical experience) in successfully including (elements of) history of mathematics in the teaching of mathematics?

HiMEd – the teacher perspective

- What minimal/satisfactory level of command of history of mathematics can we reasonably attempt to achieve in teacher training?

- Sub-issue: *The able reader*: knowledge of available sources, distinction between primary and secondary sources (more generally, the ability to identify the nature of a source), ability to assess a document with a critical mind, deontological aspects (basically, citing one's sources, indicating alterations when altering a text).

- Sub-issue: *The epistemological toolbox*: what descriptive/analytical concepts do we wish to make available to teachers? Concepts such as: proof-generated concept, zero-definition, conceptual differentiation, analysis/synthesis, epistemic object/tool, etc. Beyond the toolbox, are there "facts" about the "nature of mathematics" that we find we ought to teach (cf. the wealth of literature in physics education on the "nature of science")?

- To what extent should we expose (future) teachers to elements of history of mathematics that have no direct connections with classroom contents (in particular to enrich their "image" of the parts of higher mathematics, which they studied but will not teach)?

HoMEd – the mathematical education landscape

- Lessons from history that can be learned from the construction of the curriculum: Who is the curriculum mainly for? What "big" problems or issues does it aim to resolve? Who benefits most in the short and long run? What are the preferences of areas and topics from mathematics that are being promoted – and why? Who become the developers (and carriers) of the curriculum and how?

- How are mathematical institutions built and are they linked with the new curricula or aims of the society?

- How are cultural values created, narrated, and developed within the new mathematics education landscapes?

- What are the elements by which the tradition in mathematics education, practice, and research is perpetuated?

- What are the outputs of the new curricula/institutions/new mathematical education landscape (the material, the ephemeral, i.e. new values)?

In the following, we give examples of some of the specific questions addressed for each of these four topics. We conclude the report with some selected reflections related to the areas of questions.

SELECTED CONCLUSIONS

TWG12 participants – within both the small group and whole group discussions – had much to offer regarding the several subquestions related to the role of large-scale and small-scale surveys of history of mathematics. Several participants shared the view

that using a general survey of history (i.e., "global view") helps to create a cultural landscape, which includes and accommodates multiple tools, concepts, and ideas – and which establishes a meaningful lens to use from the outset. Group discussions during CERME9 consistently returned to the notion that accessing and reading general surveys of history of mathematics provides a good starting point from which to approach resources. However, it was also important to access different types of resources so that practitioners would be equipped to address different views that emerge from history of mathematics in mathematics education. Participants also offered several examples of general survey textbooks and sourcebooks that would serve practitioners.

Given the current educational landscape in several countries, particularly regarding curriculum reform, the participants of TWG12 spent a great deal of time discussing lessons that can be learned from the construction of curriculum over time. When considering the question, *For whom is the curriculum constructed?* participants believed that a country's mathematics curriculum is for the ministers of education. However, this also raised further questions in the group's discussion, such as, *What does 'curriculum' mean?* That is, there are several meanings and contexts that apply and what might be considered 'curriculum' by one may not hold for another. Our group also discussed history in a different way when considering the questions of the fourth topic area. For example, we thought of historical heritage, and questioned whether mathematics curriculum had caught up with what is needed. And, of particular interest to many of the TWG12 participants, we raised the question of: *How can history inform the decisions that are made with regard to mathematics curriculum?*

We look forward to exploring this issue in particular at the next CERME.